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Engineering Design File

Process and Treatment Overview for the Minimum Treatment Process

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INEEL
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5. Summary:

This document presents an overview of the "minimum treatment" process for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) wastes at the Staging, Storage, Sizing, and Treatment Facility (SSSTF). Under this option, soil from three CERCLA sites at Waste Area Group (WAG) 3 and one site from WAG 4 are used as the design basis for a stabilization treatment operation. This represents a significant departure from the basis presented in the *Preliminary Design Report (30% Design)* as this reduces the potential waste volume from 36,000 to 2060 yd^3. Pertinent information is reiterated from the 30% design report as it applies to the minimum treatment option, including characterization data of the targeted wastes and the approach for stabilizing the soil wastes. Finally, a list of design constraints and requirements for a stabilization unit is given that is similar to a requirements list released to potential vendors. In addition to treating soils, the stabilization unit will be equipped to accommodate small volumes of aqueous liquids/sludges.

6. Review (R) and Approval (A) and Acceptance (Ac) Signatures:

(See instructions for definitions of terms and significance of signatures.)

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CONTENTS

TABLES

ACRONYMS

AOC	area of contamination
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CWID	CERCLA Waste Inventory Database
DOE	U.S. Department of Energy
DOE-ID	U.S. Department of Energy Idaho Operations Office
EDF	Engineering Design File
EPA	U.S. Environmental Protection Agency
HWMA	Hazardous Waste Management Act
ICDF	INEEL CERCLA Disposal Facility
IDW	investigation-derived waste
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
LDR	land disposal restriction
OU	operable unit
PCB	polychlorinated biphenyl
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
RFQ&I	Request for Qualification and Information
ROD	Record of Decision
SSS	Soil Stabilization System
SSSTF	Staging, Storage, Sizing, and Treatment Facility
TCLP	toxicity characteristic leaching procedure
TSCA	Toxic Substances Control Act
WAG	waste area group

Process and Treatment Overview for the Minimum Treatment Process

1. INTRODUCTION

The U.S. Department of Energy Idaho Operations Office (DOE-ID) authorized a remedial design/remedial action (RD/RA) for the Idaho Nuclear Technology and Engineering Center (INTEC) in accordance with the Waste Area Group (WAG) 3, Operable Unit (OU) 3-13 Record of Decision (ROD) (DOE-ID 1999).

The ROD requires Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remediation wastes generated within the Idaho National Engineering and Environmental Laboratory (INEEL) boundaries to be removed and disposed of on-Site in the INEEL CERCLA Disposal Facility (ICDF). The ICDF, which will be located south of INTEC and next to the existing percolation ponds, will be an on-Site, engineered facility meeting U.S. Department of Energy (DOE) Order 435.1, Resource Conservation and Recovery Act (RCRA) Subtitle C (42 USC 6921 et seq.), Idaho Hazardous Waste Management Act (HWMA) (HWMA 1983), and Toxic Substances Control Act (TSCA) polychlorinated biphenyl (PCB) landfill design and construction requirements (15 USC 2601 et seq.). The ICDF will include the necessary subsystems and support facilities to provide a complete waste disposal system.

The major components of the ICDF are the disposal cells, an evaporation pond consisting of two cells, and the Staging, Storage, Sizing, and Treatment Facility (SSSTF). The disposal cells, including a buffer zone, will cover approximately 40 acres, with a disposal capacity of about 510,000 yd^3. The SSSTF will be designed to provide centralized receiving, inspection, and treatment necessary to stage, store, and treat incoming waste from various INEEL CERCLA remediation sites prior to disposal in the ICDF or shipment off-Site. All SSSTF activities shall take place within the WAG 3 area of contamination (AOC) to allow flexibility in managing the consolidation and remediation of wastes without triggering land disposal restrictions (LDRs) and other RCRA requirements, in accordance with the OU 3-13 ROD. Only low-level, mixed low-level, hazardous, and limited quantities of TSCA wastes will be treated and/or disposed of at the ICDF. Most of the waste will be contaminated soil, but debris, along with liquids, sludges, and investigation derived waste (IDW), will also be included in the waste inventory. ICDF leachate, decontamination water, and water from CERCLA well purging, sampling, and well development activities will also be disposed of in the ICDF evaporation pond.

This document discusses the "minimum treatment" process for the SSSTF. By "minimum treatment" is meant a design capacity that will accommodate the soil wastes, if treatment is required, from the WAG 3 sites CPP-92, CPP-98, and CPP-99, and the WAG 4 site CFA-04 (DOE-ID 2000a). In addition, this minimum treatment facility will be able to treat small volumes of aqueous liquids/sludges containing chemical and radiological constituents similar to those of the soil wastes or those waste streams where "placement" has occurred and treatment is required.

2. BACKGROUND

The *Preliminary Design Report (30% Design)* for the SSSTF identified requirements and described the essential functions of the facility, which included a staging area, a treatment building, a decontamination facility, and an administration building. The report also included an investigation of the wastes (primarily soils) that would be processed through the facility and designated option paths for these wastes. Eight waste streams, totaling about 36,000 yd^3, were identified as potentially leaching heavy metals above RCRA standards and, therefore, treatment of these wastes is presumably necessary. The *Preliminary Design Report* also identified a preferred treatment technique, namely, stabilization, with a cement or blended cement binder (DOE-ID 2000a).

This Engineering Design File (EDF) refines the 30% design by targeting the waste streams that will likely require treatment. Soils associated with CPP-92, CPP-98, CPP-99, and CFA-04 are being considered. This results in reducing the waste potentially requiring treatment from about 36,000 to 2,060 yd^3, which allows significant modifications to the process and facilities proposed in the *Preliminary Design Report*. The most significant deviation is the elimination of a separate treatment building for processing the wastes. Instead, a portion of the decontamination facility will be used for stabilizing the waste.

3. WASTES FOR MINIMUM TREATMENT

3.1 Waste Sources

The minimum treatment option targets wastes from CPP-92, CPP-98, and CPP-99 from WAG 3, and CFA-04 from WAG 4. The physical, chemical, and radiological characteristics of these waste streams were investigated and presented in the *Preliminary Design Report* (DOE-ID 2000a). It is anticipated that prior to and during operation of the ICDF, small volumes of additional waste streams with similar contaminants will be identified that will require treatment. Only highlights from the report are given herein; for a more thorough discussion, the original document should be consulted. The majority of WAG 3 wastes are packaged in poly-lined wooden boxes measuring either 2 × 4 × 8 ft or 4 × 4 × 8 ft. The boxes of wastes have been further categorized as being either "soil" or "debris." This breakdown is given in Table 1 for the targeted wastes. The designation as soil or debris is significant as only the boxes of soil will potentially require treatment by stabilization. The debris will not be stabilized, but will instead undergo an alternative debris treatment. The waste from WAG 4 is not currently packaged and may be received as bulk soil.

3.2 Chemical Information

The EDF-1540 documents the investigation of the CERCLA Waste Inventory Database (CWID) (DOE-ID 2000b) and interviews of cognizant site personnel to determine the analytical data available and waste codes applicable for each site (EDF-1540). Tables 2, 3, and 4 present the results of this investigation. Inspection of these tables reveals a scarcity of data. Sites CPP-98 and CPP-99 report no information for RCRA heavy metals. Site CPP-92 has a reported mercury level (based on total metals analysis) of 10.4 mg/kg, while CFA-04 reports total metal values for chromium, mercury, and silver that could potentially require this site to carry hazardous codes for these metals. As pointed out in EDF-1540, total metals analysis is distinctly different from the toxicity characteristic leaching procedure (TCLP), which is the Environmental Protection Agency (EPA) standardized test by which a sample is determined to be hazardous. In the absence of a valid TCLP determination, the total metals analysis was used to estimate a bounding (worst case) leaching value. Assuming complete mercury solubility, the TCLP results in an approximate 20-fold dilution from the total metals value and, therefore, a bounding "leach value" of 0.52 mg/L is assigned to the CPP-92 waste site. This is above the 0.20 mg/L characteristic hazard level; therefore, the site has the potential to be hazardous for mercury. This estimate assumes complete solubility, where no consideration is given to metal speciation or soil chemistry (pH, redox potential, and anionic makeup), which would attenuate leaching. A subsequent investigation, using statistical methods and assuming similarity to other sites, developed a "design inventory" for constituents within the sites. (EDF-ER-264) These estimates for hazardous metals are also given in Table 2.

All three WAG 3 sites have been assigned listed codes F-001, F-002, and F-005 for volatile organic compounds, and a U-134 code for hydrogen fluoride. No analytical organic data are available for these sites, however, design inventory estimates have been made and are presented in Table 3. These estimates are based on statistical methods for sites assumed similar to the targeted sites. The CFA-04 has been sampled and no organics were found above regulatory limits. Selected radionuclide information is given in Table 4. Sites CFA-04 and CPP-92 have been sampled and their corresponding radionuclide activities are given in the table. CPP-98 and CPP-99 have not been sampled and the nuclide activities are design inventory estimates primarily based on scaling factors.

The aqueous liquids/sludges have not yet been identified, and, therefore, the hazardous and radiological constituents of these wastes are not known. Each individual liquid/sludge waste will require evaluation for hazardous and radiological contents prior to entering the treatment building to ensure that each is compatible with the design codes, regulatory requirements, and special requirements (electrical, ventilation, etc.) for the process building.

Table 1. Designation of wastes targeted under minimum treatment option (EDF-1540).

Site	Volume (yd^3)	Configuration	Waste Description	Treatment Method
CFA-04	800	Not packaged	Soil	Stabilization
CPP-92	1,197	584 boxes 2 × 4 × 8 ft 5 boxes 4 × 4 × 8 ft (boxes assumed 85% full)	Soil	Stabilization (assumed)
CPP-98	30	17 boxes 2 × 4 × 8 ft (boxes assumed 85% full)	Soil	Stabilization (assumed)
CPP-99	30	15 boxes 2 × 4 × 8 ft (boxes assumed 85% full)	Soil	Stabilization (assumed)

Table 2. Analytical data and design inventory estimates of heavy metals for wastes targeted under the minimum treatment option (EDF-1540, EDF-ER-264).

	CFA-04	CPP-92	CPP-98	CPP-99
Potential waste codes:		D009	None	None
Maximum analytical value detected:				
Antimony	—[a]	—	—	—
Arsenic	—	—	—	—
Barium	—	—	—	—
Beryllium	—	—	—	—
Cadmium	6.8	—	—	—
Chromium	237	—	—	—
Lead	49	—	—	—
Mercury	439	10.4	—	—
Nickel	—	—	—	—
Selenium	—	—	—	—
Silver	121	—	—	—
Thallium	—	—	—	—
Design inventory estimate (mg/kg):				
Antimony	2.2	[b]	0.0	0.0
Arsenic	8.9	4.7[c]	4.7	4.7
Barium	300	[b]	71	71
Beryllium	0.83	[b]	0.4	0.4
Cadmium	1.6	2.8	0.32	0.32
Chromium	46	30	12	12
Lead	21	28	6.8	6.8
Mercury	58	4.6[c]	0.1	0.1
Nickel	65	20	14	14
Selenium	0.99	0.41[c]	0.8	0.8
Silver	9.9	[b]	0.28	0.28
Thallium	0.31	[b]	0.0	0.0

a. "—" indicates no data reported in CWID (DOE-ID 2000b) or that no analysis was performed.
b. No entry indicates that the metal is not expected to exceed background level.
c. Indicates a concentration reported in CWID (DOE-ID 2000b) or from a referenced report (EDF-ER-264).

Table 3. Hazardous organic waste codes, analytical data, and design inventory estimates of organic constituents for the WAG 3 sites (EDF-1540, EDF-ER-264).

	CPP-92	CPP-98	CPP-99
Waste codes:	F001, 2, 5	F001, 2, 5	F001, 2, 5
Analytical data (mg/kg):	No data	No data	No data
Design inventory estimate (mg/kg):			
1,1,1-trichloroethane	.023	.023	.023
4-Methyl-2-pentanone	.039	.039	.039
Acetone	.67	.67	.67
Benzene	.93	.93	.93
Carbon disulfide	.066	.066	.066
Tetrachloroethene	.009	.009	.009
Toluene	1.3	1.3	1.3
Tributylphosphate	.46	.46	.46
Trichloroethene	.096	.096	.096
Xylene (ortho)	.005	.005	.005
Xylene (total)	3.7	3.7	3.7

Table 4. Radionuclide data for sites CFA-04 and CPP-92 and design inventory estimates for CPP-98 and CPP-99 (EDF-1540, EDF-ER-264).

Radionuclide	CFA-04 (pCi/g)	CPP-92 (pCi/g)	CPP-98[a] (pCi/g)	CPP-99[a] (pCi/g)
Co-60	.025	1.49	0.0	0.0
Sr-90	5.39	9040	63	63
Cs-134	None detected	0.195	7×10^{-3}	7×10^{-3}
Cs-137	1.72	6.53	67	67
I-129	Not analyzed	3.1	2.5×10^{-5}	2.5×10^{-5}
Sb-125	None detected	2.07	.025	.025
U-234	22.6	5.1	.017	.017
U-235	1.60	0.23	4.4×10^{-4}	4.4×10^{-4}
Np-237	Not analyzed	0.15	1.2×10^{-4}	1.2×10^{-4}
Pu-238	Not analyzed	244.4	.033	.033
Pu-239/240	Not analyzed	24.69	.022	.022
Am-241	None detected	23.32	.012	.012

a. No radionuclide data reported in CWID (DOE-ID 2000b) for CPP-98 and CPP-99; the values in the table are design inventory estimates.

4. STABILIZATION PROCESS

Stabilizing soils contaminated with heavy metals using Portland cement, or similar hydraulic binders, is an accepted technology for rendering the soils nonhazardous. The hydraulic binders do this by reducing the leachability of the contaminant metals to acceptable levels. More than 17 Superfund sites have used or have been approved to use hydraulic binders in such a manner. Cement-type systems are not suited for stabilizing organic-bearing wastes, although some organics may be adequately accommodated at low levels (EPA 1999).

The *Preliminary Design Report* identified a Portland cement-based system as a viable method of treating the identified waste soils - see Appendix A for a summary of the trade study from the *Preliminary Design Report*. These soils are assumed to contain heavy metals as the only contaminants of concern; organic contaminants are either below regulatory concern or nonexistent in the waste. Based on this assumption, the object of stabilization is to deliver a treated soil that meets the following criteria:

- Reduce the heavy metal leachability to LDR levels
- Exhibit no free liquid.

Additionally, the project desires the stabilized soil to have a crumbly or friable consistency, i.e., a non-slab final form, as this would allow easier post-treatment handling of waste.

The requirements for a soil stabilization system wherein the soil and stabilizing reagents are feed, mixed, and eventually discharged is detailed in the Procurement Specification in Appendix B. This appendix also has a diagram of the building floor plan, which shows the proposed location of the mixer and soil feed station.

4.1 Laboratory Stabilization Tests

Laboratory tests will be conducted on samples of waste soils to ensure that stabilization will be successful. Each site that requires stabilization will obtain and send representative waste samples to the treatability lab to undergo testing. Stabilizing reagents will be added to these samples and the resultant treated material will undergo TCLP and free-liquids determination. If failure of the treated sample should occur, the initial recipe will be adjusted until satisfactory results are achieved – the Treatability Study Test Plan details these adjustments (to be provided in the ICDF Complex RA Work Plan). The lab-scale reagent additions and mixing procedure will, as close as reasonably possible, mimic the full-scale operation. The stabilization reagent will be a blended Portland cement containing the following ingredients:

- Portland cement, Type I/II (ASTM C150) – fine dry solid, flowable
- Flyash, class F (ASTM C618) – fine dry solid, flowable that acts as a solid lubricant to provide better mixing
- Granulated blast furnace slag (ASTM C989-93) – fine dry solid, flowable, with available sulfide to help bind metals
- Chemical reagents (sodium sulfide or similar) – solid or corrosive liquid

- Water (liquids and sludges requiring treatment may also be injected with the water up to the optimum moisture content).

On a dry basis (no added water), the baseline recipe will be composed of about 95wt% waste, with Portland cement supplying another 3.8%. The flyash and blast furnace slag will combine to contribute about 1wt%. Sodium sulfide, at a concentration of 500 ppm, is added to react and form insoluble compounds with the heavy metals.

5. PROCESS OPERATIONAL CONCEPT AND CONSTRAINTS

A Request for Qualification and Information (RFQ&I) has been prepared concurrently with this EDF. The objective of the RFQ&I is to determine the level of interest in the commercial sector for supplying equipment and/or processes that can deliver the desired end product. It simultaneously allows INEEL personnel to evaluate potential commercial suppliers. Information similar to that which follows has been distributed through the RFQ&I process to potential suppliers.

5.1 Operational Concept

An operation must be able to transfer the waste soil from plastic-lined wooden boxes to a mixing vessel, with dust suppression and/or controls in-place to maintain personnel exposure below established limits for specific contaminants. Once in the mixer, the soil will be combined with a hydraulic binder (Portland cement or Portland cement blend) and possibly a small amount of chemical reagents and admixtures. A minimum amount of water is also added; ideally, a relatively dry, crumbly, or friable waste/cement mixture is obtained. A high-intensity or high-efficiency mixer is desirable to ensure thorough mixing of the soil with the other ingredients. Additionally, the mixer should be able to accept a significant variation in soil particle/rubble size as segregation or screening of the waste is not anticipated. Once mixing is complete, the soil/cement must be transferred (with minimal dust release) into a permanent storage container where curing is completed.

In addition to the soil waste, liquids and sludges may also be treated at the facility. Although not identified or with known characteristics, it is presumed that the liquids and sludges will have hazardous contaminants similar to those of the soils – primarily heavy metals. The currently favored concept is to inject the unaltered liquid/sludge wastes directly into the mixer with a compatible soil waste and then add stabilizing chemicals to simultaneously treat both the injected liquid/sludge and the soil. If the waste liquid/sludge contains particularly difficult contaminants (organics or very high metals concentrations), a separate liquid treatment unit may be required before injecting into the mixer.

5.2 Process Requirements and Constraints

A treatment process is being sought that can deliver a product meeting the criteria listed in Section 4 but that is subject to the following requirements and constraints:

- The waste throughput will be 10 yd^3 per day.
- The waste must be removed from 2- × 4- × 8-ft lined wooden boxes, roll-on/roll-offs, or other approved containers.
- The waste is soil and assumed to have a size distribution as (EDF-1540):

  −10% greater than 0.75 in.

  −40% 0.75 to 0.25 in.

  −40% 0.25 to 0.0030 in.

  −10% less than 0.0030 in.
- Boxes of soil waste are assumed 85% full and weigh up to 8,000 lb.

- Reagents include fine flowable solids (cement, flyash, granulated blast furnace slag), water, and small quantities (less than 1 gal) of liquid reagents.

- Dust from the waste materials is to be contained within the treatment device or collected in some manner to minimize the spread of contamination.

- The footprint of the mixer and peripheral equipment will reside in a 900-ft^2 area, with a roof height of 17 ft at the eave and 21 ft at the pitch. (These dimensions would allow the equipment to be compatible with the current building design.)

- The unit must be able to accommodate aqueous waste liquids/sludges.

- The unit shall have self-decontamination features, such as spray wands or internal washdown systems.

6. SUMMARY

This document discusses the "minimum treatment" process where wastes from three CERCLA sites at WAG 3 and one site at WAG 4 are considered for treatment. Waste information originally presented in the *Preliminary Design Report* (DOE-ID 2000a), and subsequently augmented with design estimates, was presented. It is anticipated that prior to and during operation of the ICDF, small volumes of additional waste streams with similar contaminants will be identified that will require treatment.

An initial list of operational constraints and requirements was presented. A similar list was made available to commercial vendors through the RFQ&I process to determine the levels of interest, sophistication, and cost associated with a treatment unit. Four vendors showed an initial interest; however, only one of these had the proven capability of supplying a workable system.

7. REFERENCES

15 USC 2601 et seq., 1976, "Toxic Substances Control Act", United Stated Code.

42 USC 6921 et seq., 1976, Subtitle C, "Hazardous Waste Management," *Resource Conservation and Recovery Act of 1976*, as amended.

ASTM C150, 2000, "Standard Specification for Portland Cement," American Society for Testing and Materials, February 2000.

ASTM C618, 2001, "Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete," American Society for Testing and Materials, August 2001.

ASTM C989, 1999, "Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars," American Society for Testing and Materials, July 1999.

DOE-ID, 1999, *Final Record of Decision, Idaho Nuclear Technology and Engineering Center, Operable Unit 3-13,* DOE/ID-10660, Rev. 0, Department of Energy Idaho Operations Office, October 2001.

DOE-ID, 2000a, *Preliminary Design Report for the Staging, Storage, Sizing, and Treatment Facility (30% Design),* DOE/ID-10825, Rev. 0, Department of Energy Idaho Operations Office, December 2000.

DOE-ID, 2000b, *CERCLA Waste Inventory Database Report for the Operable Unit 3-13 Waste Disposal Complex,* DOE/ID-10803, Rev. 0, Department of Energy Idaho Operations Office, December 2000.

DOE Order 435.1, 1999, "Radioactive Waste Management," U.S. Department of Energy, July 1999.

EDF-1540, 2000, "Staging, Storage, Sizing, and Treatment Facility (SSSTF) Waste Inventory Design Basis," Rev. 0, Environmental Restoration Program, Idaho National Engineering and Environmental Laboratory, January 2000.

EDF-ER-264, 2001, "INEEL CERCLA Disposal Facility Design Inventory, Title I 30% Design Package," Rev. 0, Environmental Restoration Program, Idaho National Engineering and Environmental Laboratory, July 2001.

EPA, 1999, *Presumptive Remedy for Metals-in-Soil Sites*, EPA-F-98-054, U.S. Environmental Protection Agency, September 1999.

HWMA, 1983, "Hazardous Waste Management Act of 1983," Idaho Code Sections 39-4401 et seq.

Appendix A

SSSTF Soil Stabilization Trade Study

SSSTF Soil Stabilization Trade Study

A-1. TRADE STUDY

This section discusses similar sites that have soils contaminated with heavy metals and the technology used to remediate them. Treatability studies performed on-Site at the INEEL, other studies, and stabilization demonstrations are also included. Completion of this trade study indicates that cement-based stabilization of metal contaminated soils is an appropriate method for consideration in stabilizing INEEL contaminated soils. It also indicates that non-Portland cement based chemical systems are viable alternatives.

A-1.1 CERCLA Remediation Sites Utilizing Stabilization

Based on conversations with Environmental Protection Agency (EPA) regional project managers, information was obtained on several CERCLA remediation sites where stabilization and solidification of metal contaminated soils was conducted. In most of these sites, cement-based processes were used. Several are discussed below.

Portland Cement Based Systems

Sapp Battery CERCLA Remediation Site:

Lead and chrome were the primary contaminants of concern at this site. Remediation included ex-situ remediation of 100,000 yd^3 of soil and stabilization with 7–8% Portland cement, and a proprietary "nectite" (phosphate) agent. Treatability studies performed in support of this remediation showed that much more cement was required if the nectite agent was not used. The process used to combine the soil and stabilization agents was a continuous pug mill. One issue that was considered for this site was that some recipes, which satisfied TCLP tests, failed Synthetic Precipitate Leaching Procedure (SPLP) tests (another measure of long-term stabilization performance).[a]

Continental Steel Corporation OU-02, CERCLA Remediation Site:

Lead, cadmium, chromium, PCBs, and VOCs were primary contaminates of concern in lagoon soils at this site. A Treatability Study was performed by a remediation contractor and may be available through the Freedom of Information Act. Stabilization formulas were based on Portland cement.[b]

Schuykill Metal, CERCLA Remediation Site:

Chromium, antimony, cadmium, and lead were the RCRA metals of concern for the contaminated soils remediated at this site. Soil was stabilized with 15% Portland cement and amendments, including phosphates to complex lead. A treatability study was performed by Entech and resulted in a "low tech" mixing process.[c]

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a. Personal communications with EPA contact David Lloyd (404-562-9216) and Randal Chaffins (404-562-8929).

b. Personal communications with EPA contact Mat Mankowski, (312-886-1842) and Pat Likins State of Indiana IDEM (317-234-0357).

c. Personal communications with EPA contact Galo Jackson (404-562-8937).

Normandy Park Apartment, CERCLA Remediation Site:

This site, which is located on an old battery-recycling site, is owned by Gulf Coast Recycling. The primary contaminate of concern is lead. Surficial soil was excavated and replaced with clean soil. Remediation of the contaminated soil was performed by cement-based ex-situ stabilization with ultimate disposal in a landfill.[d]

Cedar Town Industries, CERCLA Remediation Site:

This site is an old smelter site with soil contamination of Cd, Pb, As, Be, and Sb. The site was remediated with Portland cement as the only stabilization agent. The contaminated soil was excavated, combined with cement in a pug mill and placed back in the previously excavated area.[e]

Palmerton Zinc, CERCLA Remediation Site:

Stabilization with flyash, lime, and potash of cadmium and lead contaminated soil. Superfund Site. Found in EPA (1997).

Gould, CERCLA Remediation Site:

Oregon, Stabilization of lead contaminated soil. Found in EPA (1997).

Non-Portland Cement, Chemical Systems

Midvale, Utah; EPA SITE Demonstration:

Chemical system (MBS) that uses a mixture of proprietary chemicals including sulfides. A demonstration at the EPA's Midvale Superfund site (April 1997) confirmed that MBS-treated multiple waste streams attained either fractional or non-detectable toxicity characteristic leaching procedure (TCLP) levels of leachable arsenic, cadmium, and lead. Found in the EPA Reach It Website (EPA ReachIt).

Several EPA Sites:

Sevenson's patented MAECTITE chemical treatment process renders heavy metals and radionuclides non-leachable from soil and solid waste. The principle behind the MAECTITE technology is chemical bonding rather than physical binding mechanisms. MAECTITE stimulates chemical bonding to nucleate substituted mixed mineral forms in the apatite and barite mineral groups that are stable and resistant to leaching in a variety of extraction fluids and pH ranges. Found in the EPA Reach It Website (EPA ReachIt).

A-1.2 INEEL Treatability Studies

Several RCRA treatability studies on metal contaminated soils have been conducted at the INEEL. Three of those studies are briefly described below.

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d. Personal communications with EPA contact Bill Denman (404-562-8939) and Gulf Coast Recycling contact Joyce Morales-Carmella (813-626-6151).

e. Personal communications with the EPA contact Annie Godfrey (404-562-8919). The site remediation contractor was GNB Environmental Services.

An INEL RCRA Treatability Study was performed in 1992 on Mercury-contaminated soil/sludge. The primary metal contaminant was mercury and cadmium, with cesium-137 as the primary radionuclide contaminant. The best results in this study were achieved using sulfur polymer cement (SPM) at a waste loading of 33%. Tests were not performed with Portland cement. At this waste loading, the TCLP was reduced on stabilization from 238 ppm to 85 ppm. The high clay content (60-80%) in this waste stream may have contributed to difficulty in significantly reducing the TCLP value. For more information on this study, see Gering (1993).

An INEL RCRA Treatability Study was performed in 1993 on Pb and Cd contaminated soil. A lead concentration of the untreated soil was reported at 37.6 mg/L and a cadmium concentration of 19.3 mg/L. This report indicated that at a ratio of waste to dry cement of .8, or a waste loading of 28% (on a stabilized product basis with 36% moisture content), that the stabilized product met the TCLP RCRA limits in place at the time (0.5 mg/L lead, and 1 mg/L cadmium). For more information on this study, see Haefner (1993).

An INEL RCRA Treatability Study was performed in 1994 on heavy metal contaminated soil. The untreated soil had a TCLP of 2.02 mg/L for cadmium and a TCLP of 41.4 mg/L for lead. This report indicated that at a ratio of waste to dry cement of 1, or a waste loading of 39% (on a stabilized product basis with 33% moisture content), that the stabilized product produced a TCLP of $\leq$ 0.066 mg/L for lead and $\leq$ 0.002 mg/L cadmium. For more information on this study, see Rybicki et al. (1995).

A-1.3 EPA SITE Demonstration Projects

SITE Program Demonstration Projects have been completed in an effort by EPA to advance the science of soil stabilization. Companies who have completed demonstrations on stabilization of metal contaminated soils are listed below (see EPA 1997):

- Advanced Remediation Mixing, Inc.
- Funderburk & Associates
- Solidtech, Inc.
- STC Omega, Inc.
- WASTECH Inc.

A-1.4 Commercial and Government Soil Stabilization Facilities

A-1.4.1 Chemical Waste Management

INEEL employees conducted a site visit to Chemical Waste Management in Arlington, Oregon to tour facility operations and gain an understanding of equipment and processes used in stabilizing RCRA metal contaminated soil. This facility does not process radioactively contaminated materials, but routinely processes RCRA metal contaminated soils, primarily contaminated with lead and chromium. Average annual stabilization production is 25,000–30,000 tons per year of waste material. At this site, 50-yd^3 batches of material are processed in lined pits using an excavator to mix the batch. Tacoma Seam flyash and Type C flyash are the primary stabilization agents used at this time; however, Portland cements have been used in the past. The selection of stabilization agents is primarily based on economics.[f]

A-1.4.2 DOE Site, Hanford, Washington.

INEEL employees conducted a site visit to the DOE Hanford site in Hanford, Washington, to tour facility operations and gain an understanding of equipment and processes used in stabilizing radioactively contaminated soils containing RCRA metals. The equipment observed in this visit does not operate on a continuous basis but has processed as much as forty 13-yd^3 containers in two weeks production time. At this site, batches of material were processed in a lined concrete box using an excavator to mix the batch. Portland cement stabilization ingredients were used as the primary stabilization agents.

A-1.4.3 Envirosafe

INEEL employees conducted a site visit to Envirosafe, Inc. to tour the facility and to gain an understanding of a commercial soil processing operation. This facility processes soils contaminated with heavy metals.

A-2. TECHNOLOGY SELECTION

Two potential stabilization methods have been selected; Portland Cement based systems and a chemical method (MBS). The two methods are discussed in the following sections.

A-2.1 Portland Cement Based Systems

This section discusses the selection of Portland cement-based systems for stabilizing the SSSTF waste soils. Portland cement systems were selected because of their demonstrated ability to bind heavy metals and their readily available sources. The trade study results also suggest that Portland cement systems are commonly used in similar remediation activities.

The primary contaminants of concern are barium, cadmium, chromium, lead, mercury, and silver. Based on EPA guidance documentation (EPA 1997), cadmium and lead are the most amenable to cement-based stabilization, mercury is less amenable to stabilization in cement, and silver is not particularly amenable to cement-based stabilization. One valence state of chromium, Cr VI, is not amenable to cement-based stabilization, but if it can be reduced to Cr III it can be stabilized. It is not known what the chrome speciation of any of the target soils is. The same EPA reference states:

> "Wastes containing more than one metal are not addressed here, other than to say that cement-based solidification/stabilization of multiple metal wastes will be particularly difficult if a set of treatment and disposal conditions cannot be found that simultaneously produces low mobility species for all the metals of concern. For example, the relatively high pH conditions that favor Pb immobilization would tend to increase the mobility of As. On the other hand, the various metal species in a multiple metal waste interact (e.g., formation of low solubility compounds by combination of Pb and arsenate) to produce a low mobility compound."

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f. Site visits to other treatment sites and personal communications with Brian Raivo, an INEEL mechanical engineer. Personal contact at Chemical Waste Management is Gary Fisher (541-454-3234). Personal contact at Hanford is Mike Casbon (509-372-9218).

While not certain, it appears that cement-based stabilization is a viable candidate for stabilizing INEEL waste. It is acknowledged that amendments and/or pretreatment (any treatment prior to the PC-based mixture) of waste are required to fully stabilize the INEEL waste. Cement was selected as a starting point for a number of reasons:

- Well known and established technology
- Formula can be adjusted to address a wide variety of contaminants
- Waste does not need to be dried, excess water can be solidified with the sediments
- Low materials cost
- Minimal equipment requirements
- Readily available
- Potential long-term impacts are better known than other binders
- Energy requirements are minimal.

Some of the disadvantages include:

- Tendency to form monoliths and large solids even at relatively high waste loading
- Difficulty in finding recipe for multiple metals
- Requires addition of sulfides or other reagents for Ag, Hg, and Cr^{+6}
- At least 24 hour cure time
- Potentially impacted by organic compounds and other materials in soil.

Other stabilization agents were not selected for a variety of reasons at this time; however, these agents may be included as amendments to the basic cement formulation as needed. Lime-based binders are in common use and adequately stabilize metals, but do not have the same strength and durability. Phosphate-based products are known to enhance lead stabilization, but generally sacrifice physical properties such as compressive strength. Other amendments that are considered for inclusion in the cement based mix include blast furnace slag, flyash, and sodium sulfide because of their known ability to bond and stabilize heavy metals.

A-2.2 Non-Portland Cement, Chemical Methods

As an alternative to the Portland cement-based systems, a proprietary, chemical based system has been selected. The proprietary chemical is sulfide based and is expected to bond with all of the target metals. The system is a product of Solucorp called molecular bonding system (MBS). MBS creates a sulfide bond with contaminants, effectively converting leachable ions into non-leaching sulfide molecules. The major benefit of MBS technology for stabilizing heavy metals derives from sulfides being extremely insoluble and requiring only a low volume addition to achieve high efficiency application results. Standard equipment for using MBS includes:

- A hopper for loading soils

- Dry powder chemicals silo for the MBS reagents
- A belt scale to control the MBS into the pugmill (or other mixer)
- Conveyor system to relocate treated materials.

Material prescreened to < 2 inches is loaded into a hopper where it is conveyed into the pugmill's twin auger system (the 2 inches is based on equipment used by Solucorp in the past, the actual upper limit will be based on actual equipment used for mixing). At a predetermined rate, the belt scale simultaneously delivers the MBS reagent and, if necessary, water is sprayed into the blending system to ensure chemical dispersion and homogenous mixing. After approximately 30 seconds mixing, the treated materials exit on the conveyor system for stockpiling or loading for removal to the site. Samples can be taken immediately for TCLP verification.

Some of the advantages of the MBS include:

- High waste loading, low reagent usage
- No cure time
- Provides friable, soil-like solid, does not make monoliths
- Exceptionally low solubilities
- Not pH sensitive (range of 3 – 11)
- Effective for all target metals
- Can reduce Cr^{+6} both total and leachable
- Not impacted by the presence of organic compounds.

Disadvantages:

- Cannot be used on wastewater with < 40% solids
- More expensive than Portland cement
- Does not have the degree of technological maturity as Portland cement systems.

Some of the heavy metal data is provided below (Solucorp 2001). Tables 2-1 through 2-4 provide the data on chrome, cadmium, lead, and mercury (used with permission from Solucorp)[g]:

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g. The new UTS criteria reduced the leachable chromium limit to 0.60 mg/L (from 5.0 mg/L under prior RCRA legislation). This has exacerbated the difficulty and expense of making chromium non-hazardous via traditional chromium contamination remediation methods, which entails a two-step operation that reduces Cr^{+6} to Cr^{+3}, then stabilizes the trivalent form to prevent it from leaching.

Table A-1. MBS treatment results on hazardous chromium (Cr^{+6}) compounds. (< Indicates results below the specific testing laboratory's detection limits.)

Contaminated Matrix	Untreated Total Cr^{+6} (ppm)	MBS Treated Total Cr^{+6} (ppm)	Untreated Cr TCLP (mg/L)	MBS Treated Cr TCLP (mg/L)	U.S. EPA's UTS Criteria (mg/L)
Silty Soil	1,300.0	60.0	111.0	< 0.02	0.6
Sandy Soil	980.0	46.0	84.0	0.11	0.6
Sludge	2,320.0	111.4	240.0	< 0.3	0.6

Table A-2. MBS treatment results on hazardous cadmium compounds.

Contaminated Matrix	Untreated Cadmium TCLP (mg/L)	MBS Treated Cadmium TCLP (mg/L)	U.S. EPA's UTS Criteria (mg/L)
Soil – Sandy	115.0	<0.10	0.11
Soil – Silty	67.6	<0.10	0.11
Soil – Sandy/Silty	2.4	<0.01	0.11
Baghouse Dust	13.3	<0.03	0.11
Baghouse Dust	4.1	<0.005	0.11
Smelter Waste	1.8	<0.05	0.11

Table A-3. MBS treatment results on hazardous lead and lead compounds. (< Indicates results below the specific testing laboratory's detection limits.)

Contaminated Matrix	Facility Or Waste Type	Untreated Lead TCLP (mg/L)	MBS Treated Lead TCLP (mg/L)	EPA's UTS TCLP Limit (mg/L)	MBS Dosage Rate[a]
Soil	Pigment Producer	77.0	< 0.25	0.75	3.4 %
Slag/Soil	Brass Factory	33.0	< 0.10	0.75	4.0 %
Slag/Soil/Ash	Steel Foundry	131.8	< 0.05	0.75	4.6 %
Soil	Paint Chips	66.0	0.34	0.75	3.8 %
Soil	Rifle Range	34.0	< 0.10	0.75	3.5 %
Slag	Secondary Smelter	250.0	0.05	0.75	4.6 %
Slag	Superfund Waste	13.0	< 0.03	0.75	4.6 %
Baghouse Dust	Pipe Manufacturer	10.0	0.42	0.75	3.4%
Slag	Secondary Smelter	1,600.0	0.21	0.75	4.0 %
Foundry Slag	Brass Factory	36.7	0.317	0.75	1.3%

a. Percentage of MBS reagents added on a wet weight basis.

Table A-4. MBS treatment results on mercury compounds. (< Indicates results below the specific testing laboratory's detection limits.)

Contaminated Matrix	Mercury Concentration (ppm)	Untreated Mercury TCLP (mg/L)	MBS Treated Mercury TCLP[a] (mg/L)
Clay	13,490	29.6	< 0.04
Caliche	24,180	2.54	< 0.04
Clay/Caliche	20,330	3.74	< 0.04
Silty/Sands		1.85	< 0.02
Silty/Sands		1.85	0.0051
Silty/Sands		11.0	< 0.005

a. Percentage of MBS reagents added on a wet weight basis.

A-3. REFERENCES

EPA, 1997, *Technology Alternatives for the Remediation of Soils Contaminated with As, Cd, Hg, and Pb*, U.S. Environmental Protection Agency, EPA 540-S-97-500, August 1997.

EPA Reach It, *EPA Remediation and Characterization Innovative Technologies* homepage, URL address: http://www.epareachit.org/index3.html, accessed July 2001.

Gering, K. L., 1993, *Treatability Study for the Bench-Scale Solidification on Nonincinerable LDR Low-Level Mixed Waste*, Idaho National Engineering Laboratory, External Report, EGG-WM-10533, January 1993.

Haefner, D. R., 1993, *Solidification Treatment Studies on Nonincinerable Mixed Wastes for 1993*, Idaho National Engineering Laboratory, Engineering Design File, WROC-EDF-212, 1993.

Rybicki, T. M., et al., 1995, *1994 Treatability Study for the Bench-Scale Treatment of Nonincinerable LDR Low-Level Mixed Waste*, Idaho National Engineering Laboratory, Internal Report, INEL-95/185, July 1995.

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Appendix B

SPC-1481, SSSTF Soil Stabilization System Procurement Specification

Document ID: SPC-1481
Revision ID: 0
Effective Date: 03/12/02

A-E
Procurement Specification

PROJECT FILE NO. 020996

SSSTF Soil Stabilization System (SSS) Procurement Specification

Prepared for:
U.S. Department of Energy
Idaho Operations Office
Idaho Falls, Idaho

INEEL
Idaho National Engineering and Environmental Laboratory

Form 412.14
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DOCUMENT MANAGEMENT CONTROL SYSTEM (DMCS)
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Attachments:

1.0 SCOPE

1.1 General

The Idaho National Engineering and Environmental Laboratory (INEEL), a United States Department of Energy National Laboratory operated by Bechtel BWXT Idaho, LLC (BBWI) will procure a Soil Stabilization System (SSS). This Specification details the requirements for the SSS which will be located within the Staging Storage, Sizing, and Treatment Facility (SSSTF) at the Idaho Nuclear Technologies Engineering Center (INTEC), Scoville, Idaho.

The SSS shall have the capability of stabilizing soils as required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) actions that contain Resource Conservation and Recovery Act (RCRA) hazardous substances along with certain radionuclides. The stabilization treatment process shall reduce the leaching characteristics of RCRA contaminants within the soil to acceptable levels as determined by the Toxicity Characteristics Leaching Procedure (TCLP). The TCLP is the responsibility of BBWI.

The soil is currently being stored in 2' x 4' x 8' wooden boxes lined with 10 mil plastic liners at the INTEC facility. INTEC is a radiologically controlled facility within the boundaries of the INEEL. The assumption is made that the boxes of soil weigh approximately 8,000 pounds each. The quantity of soil to be stabilized is a minimum of 2,060 cubic yards. The SSS shall be capable of treating a minimum of 10 cubic yards of soil per day.

It is required that the Subcontractor provide and install all components into a functionally integrated soil stabilization package complete and ready for use in accordance with the Equipment Manufacturer's installation procedures. The end product will be moist, friable soil for the stabilization of RCRA listed materials. Transportation of the remediated soils to the INEEL CERCLA Disposal Facility (ICDF) shall be performed by BBWI.

The SSS shall also be capable of handling aqueous liquid/sludge waste streams. These waste streams have yet to be determined, and as such, will require evaluation for hazardous and radiological contents prior to entering the SSS. The waste streams will be injected into the mixer on top of solidification/stabilization agents. These agents consist of a blend of Portland Cement and trace quantities of sodium sulfide and plasticizers. The end result will be a homogenous waste solid with excellent leach resistance.

All equipment and components contained within this Specification shall be new and unused. All electrical equipment and components shall be UL listed.

The Subcontractor shall also be responsible for all support equipment and safety features that provide for a complete system that is fully operational and compliant with all Occupational Safety and Health Administration (OSHA) regulations.

1.2 Work Included

This Specification covers the Subcontractor and Equipment Supplier's requirements for the design, fabrication, assembly, installation, testing and training for the SSS. It is not the intent of this Specification to completely define all details of installation. Equipment shall be designed, fabricated, assembled, and installed in accordance with this Specification and the Equipment Supplier's and Subcontractor's Standard Practices when such practices do not conflict with this Specification.

The Equipment Supplier must submit a point-by-point response, explaining how the proposed SSS conforms to each of the identified Specification requirements.

The SSS shall be delivered and completely assembled and installed at the INEEL by the Subcontractor. The Equipment Supplier shall provide technical support and training to BBWI during start-up and testing as indicated in Sections 8.1.3 and 8.3 of this Specification.

The following shall be delivered to BBWI:

1. A complete and fully integrated design of the SSS that includes drawings, material specifications, equipment lists, fabrication details, and assembly/installation instructions. See Section 5 of this Specification for further design details.
2. All of the components listed in Section 1.4.5 (Soil Stabilization System)
3. Vendor Data Submittals in accordance with the Vendor Data Schedule and this Specification.
4. A fully operational system in full compliance with all Contract requirements.
5. Any special tools required for operation and maintenance of the system and in accordance with the Special Tools List identified in Section 4.2.

1.3 Work Not Included

Equipment, unless specified herein, is not included. The following items shall not be included in the scope of work of the Subcontractor:

- Radiation monitoring and any required shielding local to the SSS shall be furnished and installed by BBWI.
- The design, fabrication, and installation of the liquid/sludge waste injection system shall be the responsibility of BBWI. Only the multi-port injection connections on the mixer are included in the Equipment Manufacturer's Scope of Work.
- The Subcontractor shall not provide forklifts. Providing forklifts will be the responsibility of BBWI.

2.0 QUALIFICATIONS

2.1 Minimum Qualifications of Equipment Supplier

The Equipment Supplier shall submit documentation containing evidence of prior experience with the design, fabrication, assembly, installation and delivery of Soil Stabilization Systems employing field proven (not theoretical, prototype, laboratory or first run) technology, similar to the system required under this Specification. There must also be prior evidence that the system can handle liquid/sludge aqueous waste streams.

The equipment shall be supplied by a firm that has prior related experience in the manufacturing and installation of Soil Stabilization Systems.

1.4 Definition of Terms

1.4.1 "FURNISH" or "PROVIDE" shall mean to supply, equip and deliver.

1.4.2 "INTEC" shall mean Idaho Nuclear Technology and Engineering Center.

1.4.3 "CONTRACTOR" shall mean Bechtel BWXT Idaho, LLC (Limited Liability Company) and its successors and assigns. Also referred to as BBWI.

1.4.4 "SUBCONTRACTOR" shall mean the persons, firm, or corporation selected by the Contractor to install the equipment specified herein.

1.4.5 "EQUIPMENT MANUFACTURER" or "EQUIPMENT SUPPLIER" shall mean the persons, firms, or corporations selected by the Subcontractor to design, fabricate, and provide the equipment and services specified herein.

1.4.6 "SOIL STABILIZATION SYSTEM" (SSS) shall represent the mixer, box unloader, reagent addition system, air scavenger system (which confines the entire SSS System), ventilation system including make-up air system (if required), equipment cleaning system and remote station process control. It is the responsibility of the Equipment Supplier to provide the entire Soil Stabilization System as required by this Contract.

1.4.7 "REAGENT" Reagents may be added to the cement/soil material to stabilize the heavy metal contaminants or to modify the cement physical properties. Chemical reagents may be added to convert the heavy metals to insoluble, and therefore less toxic, forms. Admixture reagents, such as water-reducers or plasticizers, are added to give the cement/soil combination better flow characteristics or greater slump. These reagents may be added as either liquids or solids. The amount of reagents added is typically small – enough to achieve an approximate concentration of 1 to 20 part per million in the product cement/soil. Reagents consist of a blend of Portland Cement with trace quantities of sodium sulfide and plasticizers. The addition of reagents to the SSS is the responsibility of the Contractor.

1.4.8 "TOXICITY CHARACTERISTICS LEACHING PROCEDURE" (TCLP) This is an EPA standardized laboratory procedure for determining whether a waste is hazardous due to the leachability of heavy metals. For solid wastes, approximately 100-gram samples of material are required for the test.

1.4.9 "CPP" shall mean Chemical Processing Plant.

3.0 APPLICABLE CODES, STANDARDS, AND REFERENCES

The design of the SSS, as well as the materials used in their construction, shall be as recommended by the Equipment Manufacturer unless specified by the Contractor, and shall comply with the revision of applicable regulations, safety codes, specifications and standards in effect on the date of this Contract, including applicable technical definitions, as acknowledged and accepted in the industry, and as specifically designated by this Specification, which include, but are not limited to, the Codes and Standards in Section 3.1.

All designs, material, equipment and services provided by the Equipment Supplier shall comply with all Federal, State and local laws, regulations and codes, and all applicable Specifications and Standards including, but not limited to, those listed in 3.1.

Equipment and services furnished by the Equipment Supplier shall comply with the latest revisions of the Occupational Safety and Health Act of 1970 (OSHA), and all applicable standards thereunder.

In the event of any inconsistency between Codes, Standards and this Specification, the inconsistency shall be resolved by giving precedence as follows: (a) Codes, (b) Standards and (c) Specification. The Equipment Supplier shall refer any conflicts promptly in writing to the Contractor using the Subcontractor Field Problem form.

3.1 National Codes and Standards

ACGIH	-	American Conference of Governmental Industrial Hygienists
AISC	-	American Institute of Steel Construction
ANSI	-	American National Standards Institute
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society for Testing and Materials
AWS	-	American Welding Society
CEMA	-	Conveyor Equipment Manufacturer's Association
CERCLA	-	Comprehensive Environmental Response, Compensation, and Liability Act
CPMB	-	Concrete Plant Manufacturer's Bureau. (#101-96)
IEEE	-	Institute of Electrical and Electronics Engineers
ISA	-	Instrument Society of America
NEC	-	National Electric Code
NEMA	-	National Electrical Manufacturer's Association
NFPA	-	National Fire Protection Association
NIST	-	National Institute of Standards and Technology
NRMCA	-	National Ready Mix Concrete Association. (#186)
OSHA	-	Occupational Safety and Health Act
RCRA	-	Resource Conservation and Recovery Act
SSPC	-	Steel Structure Painting Council
UBC	-	Uniform Building Code
UMC	-	Uniform Mechanical Code

UL	-	Underwriters Laboratories, Inc., Standards and Directories of Listed Products

4.0 SUBMITTALS

As a minimum, the Subcontractor shall provide the Contractor with the submittals referenced in this Section. The Subcontractor shall be responsible for all submittals that come from the Equipment Supplier. Additional submittal requirements are defined in the Vendor Data Schedule and applicable Contract documents. The quantities and submittal schedule will be included in the procurement RFP package and is also included in the attached Vendor Data Schedule.

4.1 Inspection Test Plans/Procedures/Reports

This includes the following:

Performance Tests (Factory Preshipment): Performance test plans, procedures, and reports as outlined in Section 7.2 of this Specification.

Performance Tests (On-Site, INEEL): Performance test plans, procedures, and reports as outlined in Section 7.3 of this Specification.

4.2 Spare Parts and Special Tools List

The Subcontractor shall submit to the Contractor a list of recommended spare parts and any special tools required for operation and maintenance of the SSS components. This includes corresponding Suppliers of each component and their phone numbers. The list shall include pricing and delivery information valid for one year after delivery of the equipment on a regular basis.

4.3 Special Packaging/Shipping/Rigging

The Subcontractor shall submit a Packaging/Shipping/Rigging Procedure in accordance with Section 9.0 of this Specification.

4.4 MSDS's

Prior to fabrication release, the Contractor shall approve any Material Safety Data Sheets (MSDS's). The Contractor shall submit MSDS's for approval on any material that periodically requires disposal. This allows the Contractor to verify INEEL CERCLA Disposal Facility (ICDF) waste acceptance and disposal requirements. Suspect or known carcinogenic materials are not acceptable for use.

4.5 Cleaning

The Subcontractor shall submit a cleaning procedure that ensures the SSS equipment is free of debris and contaminants. See Section 6.3 of this Specification for further details.

4.6 Design Verification

See Section 5.9 for these requirements.

4.7 Operations and Maintenance Manuals

The Subcontractor shall furnish six (6) copies of the Operations and Maintenance Manual per the Vendor Data Schedule.

The Operations and Maintenance Manual shall cover the installation, operation and maintenance of the equipment in detail. The manual shall describe the method of installing each component in step by step detail. All drawings, diagrams, and record forms required for the installation shall be included and incorporated in the manual.

The O&M manual shall be divided into 3 separate sections, (1) Operations, (2) Maintenance, and (3) Installation. Each copy of the Operations and Maintenance Manual shall be bound in a three-ring binder(s) that includes following minimum information:

1. Compilation of all technical and design data and related information for the maintenance and operation of equipment furnished by the Equipment Supplier.

2. Technical description of each device, subsystem, and system.

3. Engineering data, all final layouts and wiring diagrams.

4. Shipping, receiving, and storage instructions.

5. Installation instructions.

6. Device settings.

7. Commissioning and field-tests.

8. Adequate troubleshooting detail shall be provided such that the Contractor technicians, trained in accordance with the requirements in this Specification, are able to isolate a fault to a specific component or circuit board, remove and replace the faulty component, and return the drive to operation.

9. Step-by-step sequence of normal start-stop and emergency shutdown operations of all systems.

10. Preventative maintenance instructions.

11. Guide to trouble shooting all equipment.

12. Subtier items that identify make/model of components furnished. Price and warranty information shall be included with Subtier components.

13. List of recommended spare parts and special tools list.

14. Technical information and catalog cuts for all products specified by this Specification.

15. Final "paper" drawings reduced and folded.

16. Typed index and separator tabs marked with the name of the equipment described therein.

17. Original Equipment Manufacturer's printed information describing the EXACT equipment furnished. Each sheet shall be marked with the EXACT nomenclature for the equipment used in the specific system.

18. Equipment information shall be highlighted to show EXACTLY what capacities and EXACTLY what options have been provided. The highlights must be reproducible on a copy machine.

19. The Operations and Maintenance Manual shall cover all items supplied, including materials that the Equipment Supplier obtained from Subtiers. The Equipment Supplier shall be responsible for securing the manuals and lists for all items furnished and for incorporating them in the manuals.

20. The Operations and Maintenance Manual shall include only final, as-installed, system data.

4.8 Drawings

The Equipment Supplier shall submit prints of the final drawings disclosing the configuration of SSS equipment. These drawings shall document the mechanical, electrical, and instrumentation configuration. The drawings shall be of sufficient detail to allow the Contractor to identify and evaluate the systems and components for installation, operation, maintenance, and repair activities without detailed physical inspection of the actual hardware. Drawings shall be submitted in both paper and AutoCAD 2000 only. The maximum size of all drawings shall be 24" by 36" unless otherwise approved by the Contractor.

The Subcontractor shall submit the following drawings for review and approval prior to fabrication:

1. Schematic drawings.

2. General arrangement drawings that show all equipment locations and layout within the facility. Additionally, these drawings shall show minimum and maximum allowable distances between equipment.

3. Structural detail drawings showing special provisions in the floor slab due to loads generated by the equipment contained within this specification (i.e., special foundation configurations). The Equipment Supplier must coordinate with the post tension floor designer for this activity.

4. Assembly drawings.

5. Drawings shall include the weight of each unit.

6. The Subcontractor shall submit Equipment Supplier's drawings showing recommended installation methods of the SSS equipment.

4.9 Design Calculations

The Subcontractor shall submit the Equipment Supplier's design calculations for:

All structural design details, electrical equipment loads, ventilation leakage rates, and dust emissions.

All design calculations shall be reviewed and stamped by a Registered Professional Engineer of the State of Idaho.

4.10 Service Requirements

The Subcontractor shall submit to the Contractor service requirements (e.g., electrical, raw water) necessary for INEEL personnel to plan and perform SSS service connections at the INEEL.

4.11 Product Data

The Subcontractor shall submit Equipment Manufacturer's technical data per the Vendor Data Schedule. Data shall include the Equipment Manufacturer's name, address, telephone number, model number, and specific information on performance, operating parameters, ratings, capacities, characteristic efficiencies, catalog data, equipment dimensions, evidence of compliance with safety and performance standards, and other data required to fully describe the equipment. The data shall also be identified with the tag number of the equipment or device for which the data applies.

4.12 Warranty

Include the name, address, and telephone number of the firm(s) providing the warranty service. The warranty for the complete Soil Stabilization System shall be warranted for a period of two (2) years from the date of initial start-up. This includes, but is not limited to, repair parts, labor, reasonable travel expenses, and expendables. Multiple warranties for individual components will not be acceptable. Complete warranty documents must be provided. Response time for warranty items is 2 weeks.

4.13 Quality Assurance

The Subcontractor shall submit Quality Assurance program requirements. See Section 7.1 for details.

5.0 DESIGN

5.1 General

The SSS shall be designed by the Equipment Supplier to provide for a fully functional system and to perform as specified in a safe and efficient manner. This section defines the design requirements for the SSS.

5.1.1 Site Conditions

The site conditions are as follows:

Elevation above Mean Sea Level	5000 ft.
Ambient Outdoor Temperature Range	-20° F to 105° F
Average	45° F
Ambient Outdoor Relative Humidity Range	15% to 90%
Average	33%
Ambient Indoor Temperature Range	45° F to 95° F
Average	75° F
Ambient Indoor Relative Humidity Range	10% to 80%
Average	30%

Freeze protection features shall be employed by the Subcontractor on any outdoor equipment due to the winter conditions at the INEEL.

5.1.2 Waste Soils

The following particle size distribution approximates typical soil gradations:

Sieve Size	% Passing
3"	100
1 ½"	95
¾"	72
½"	60
#4	30
#8	20
#50	12
#200	7.5

A representative stabilization mix design (proportioned by weight) is as follows:

	Nominal	Range
Soil	80%	35-80%
Cement *	10%	10-50%
Water	10%	10-15%

*Cement may be blended with Class F Fly Ash, Blast Furnace Slag, or other pozzolans.

5.1.3 Aqueous Liquid/Sludge Wastes

The aqueous liquid/sludges have not yet been identified, and therefore, the hazardous and radiological constituents of these wastes are not known. Each individual liquid/sludge waste will require evaluation for hazardous and radiological contents prior to entering the treatment building to ensure that each is compatible with the design codes, regulatory requirements, and special requirements (electrical, ventilation, etc.) for the process building. It is the intent of the Contractor that the SSS be flexible in its operation so these types of wastes can be stabilized.

5.1.4 Inputs/Outputs

Inputs:

Boxed soils shall be shipped from existing storage location to the SSSTF by Contractor trucks.

Boxed soils shall be loaded onto the Box Unloader portion of the SSS by Contractor forklifts.

Liquid wastes shall be shipped to the SSSTF and injected/pumped into the SSS by Contractor personnel.

Outputs:

The end package shall be 2' x 4' x 8' boxes and a mobile loading device capable of discharging the treated soil mixture into a standard truck-mounted 20 cubic yard roll-on/roll-off container.

Removal of containerized treated soils from the SSS and transfer to temporary or permanent storage shall be accomplished by the Contractor.

5.1.5 Subcontractor Furnished Systems

The Subcontractor will provide the following:

Building – The building is a UBC Occupancy: F2, UBC Building Type: II N. See attached floor plan (drawing A-1) for space availability of Soil Stabilization System. The roof is 17 feet high at the eve and 21 feet at the pitch. Access to the building will be through 14 x 14-ft overhead doors. There is 1,538 ft^2 of floor area of which 900 ft^2 is usable for the permanently installed mixing operation (see Treatment Area, room 112 of attached drawing A-1).

Power will be supplied at 480 volt, 3 phase with 100 kW available for continuous usage by the Contractor. An additional 200 kW of heating load can be administratively controlled to run intermittent processes. This 200 kW will be available on a continuous basis during the non-heating spring to fall months. The Subcontractor shall submit electrical requirements for their proposed system.

Raw water is supplied to the building for use with the stabilization process and equipment washdown system via a pressurized water system. Nominal pressure is 40-60 pounds per square inch.

5.1.6 Standard Commercial Product

The SSS shall be in accordance with the requirements of this Specification and shall be the Equipment Manufacturer's standard commercial product to the greatest extent possible. Standard features of the Equipment Manufacturer's standard commercial product line that exceed the requirements of this Specification are not specifically prohibited by this Specification and may be included in the equipment to be furnished. A standard commercial product is a product, which has been sold or is being currently offered for sale on the commercial market through advertisement, by Equipment Manufacturer's catalogs, or brochures, that represents the latest production model.

5.1.7 Design Loads

Dead and Live Loads: Combinations of these loads shall conform to ASCE 7-98.

Seismic Loads: Seismic loads shall be determined and applied in accordance with the Uniform Building Code (UBC), 1997 edition, using Seismic Zone 2B, Soil Profile S_D, and an Importance Factor of 1.0.

5.1.8 Workmanship

The SSS equipment shall be designed and packaged to withstand the strains, jars, and vibrations incidental to shipping, storage, and installation in addition to those experienced during operation.

5.1.9 Lifting and Tie Down

The SSS equipment shall be equipped with lifting and tie-down attachments per Equipment Manufacturer's standard design for the selected equipment. The Equipment Manufacturer(s) shall submit documentation identifying the tie-down, rigging and hoisting information. The lift information shall include a diagram showing the lifting attachments and lifting slings, the capacity of each attachment, and the required length and size of each sling. The center of gravity shall be shown. The tie down information shall identify configuration and the instructions for transport. Suitable lifting lugs shall be provided for hoisting motors during installation and for maintenance purposes as well.

5.2 Mixer

The mixer shall be capable of providing a homogeneous blend of soil and reagent and have a minimum capacity of 13,000 pounds. The system must be robust enough to provide mixing for a wide range of feed with aggregates up to 6" while at the same time providing enough sheer to generate a homogeneous mixture. At the same time, the mixer must be able to accept and adequately mix aqueous liquid/sludge wastes with no leakage.

After the mixer has produced a homogeneous blend of contaminated soil and reagent, the mixer shall be capable of delivering the soil into 2' x 4' x 8' boxes and a mobile loading device capable of discharging the treated soil mixture into a standard truck-mounted 20 cubic yard roll-on/roll-off container.

Minimum salient features of the mixer include but are not limited to:

- Material cleaning/screening system.

  A material cleaning/screening system will be necessary to keep the mixer free of debris that may impact the operation of the mixer. This system shall be capable of self-decontamination. Examples include, but are not limited to: internal washdown system or a high-pressure wand for final clean out. The mixer compartment shall be designed to collect water and also have a 3-inch drain plug in the bottom for washdown liquid disposal. Disposal of the washdown liquid is the responsibility of the Contractor.

- Self-lubricating system for the mixing shafts.

- A mixing tank liner that provides for a 15 year wear life.

- A port capable of accommodating a moisture probe. Recommended port size is 1" NPT. One port plug shall be provided.

- A multi-port (four port) liquid/sludge injection connection for flexibility in waste stream injection. Recommended port size is 2" NPT. Four port plugs shall be provided.

- An automatic discharge door that is equipped with a hand pump for emergency discharging.

- A structurally sound maintenance and access platform constructed per OSHA Standards. Platform design and drawings shall be submitted to the Contractor prior to shipment for assembly and installation by Subcontractor at the INEEL.

- Dust confinement skirting and dust pick-ups capable of tying into the air scavenger system.

5.3 Box Unloader

The soil handling system (Box Unloader) must be capable of unloading a 2' x 4' x 8' box with contents weighing 8,000 pounds into the mixer with minimal amount of soil transfers and no contamination exposure to personnel. The contamination control confinement system shall have dust pick-ups capable of tying into the air scavenger system. Dust levels must be maintained below 40 $\mu g/m^3$ during unloading operations. It is anticipated that confined equipment would need to be used to accomplish this task. There must also be provisions made for the emptying of the soil boxes without allowing the plastic liner to fall into the mixer.

Manual removal of lids from the 2' x 4' x 8' waste boxes will occur within the air scavenger system and be the responsibility of the Contractor.

This system shall be capable of automatically introducing as much as 6,400 pounds of reagent into the mixing unit either by the box unloader or other means. Dust levels during this operation must also be kept below 40 $\mu g/m^3$

5.4 Air Scavenger System

An air scavenger system shall provide total elimination of fugitive dust emissions during soil transfer, soil mixing, and soil unloading activities. The mixer enclosure shall be sealed or controlled such that fugitive dust does not occur. Dust levels must be maintained below 40 $\mu g/m^3$ during all operations. If possible, a minimum vacuum of 0.10-in. w.g. must be maintained on the soil feed system. Exhaust air shall be filtered with at least a single roughing filter and dual nuclear grade HEPA filters. The HEPA filters shall be 24" x 24" x 12", Flanders, GGF, fluid seal type or equivalent. Air introduced into HEPA filter banks must be maintained below

90% relative humidity. This requirement shall be accomplished by utilizing duct heaters as necessary. The filter housing shall be Flanders/CSC or equivalent, and shall be complete with in-place DOP test sections upstream and downstream of each HEPA filter. Differential pressure gages shall be installed to monitor pressure drop across the pre-filter bank and each HEPA filter bank. The exhaust system shall be designed to meet the requirements of NFPA-801 (Fire Protection for Facilities Handling Radioactive Materials). The Subcontractor shall evaluate the need for a baghouse filtration system upstream of the exhaust filter bank. A filtered exhaust ventilation system and a make-up air system capable of up to 4,000 cfm of air are available within the current facility design. This system may be used at the Subcontractor's option. If more air is required by the proposed system, the Subcontractor shall include with their proposal the design, delivery, and installation of a filtered exhaust air system and a corresponding make-up air system meeting the above requirements.

5.5 Remote Station Process Control Requirements

Due to the radioactive nature of the soil, the SSS shall employ remote monitoring/communication/process control. The process control/monitoring shall be programmable logic controller (PLC) based with a panel mounted display capable of displaying system parameters/alarms via a Human Machine Interface (HMI). The PLC shall be complete with power supply, CPU, rack and I/O modules (including Ethernet for remote communications). As a minimum, the process control/monitoring system shall monitor motor temperature, gearbox temperature, motor current draw, automatic lubrication system temperature and pressure, provide start/stop control and provide alarms when system operating parameters are out of normal operating range. The Subcontractor shall submit any software or programmable logic (e.g., PLC ladder logic) necessary to control and operate the SSS. Programming shall be done by the Equipment Supplier. All process system controls shall be housed in a NEMA 4X enclosure for indoor and housed in NEMA 3R enclosures for outdoor equipment.

The remote station control house shall have the following requirements:

- Capability of fitting in the space local to the SSS (See drawing A-1).
- Insulated.
- Contain a safety glass window for viewing of the SSS operation.
- Air-conditioned/heated.
- Wired for lights/recepticles.
- A personal computer station (Government Furnished Equipment) for data acquisition related to the process. The Subcontractor shall submit their hardware, software and PLC requirements to the Contractor for approval through the Vendor Data Submittal process.
- Located sufficiently far enough away from the SSS to allow for shielding as necessary.

5.6 Electrical Power

All motors shall be squirrel-cage, induction, energy efficient, high power factor type, rated for continuous operation.

Motors shall be rated 480 V, three (3) phase, 60 Hz duty and recommended for variable speed operation when driven with a Variable Frequency Drive (VFD). Motors shall have horsepower rating of not less than 115% of the brake horsepower required by the mixer when operating at design conditions. All motors shall have a minimum service factor of 1.15.

Motors shall be properly matched to the VFD for maximum motor/drive system efficiency and minimum total harmonic distortion. If the motor manufacturer does not manufacture the VFD, the Subcontractor shall obtain certification from the motor manufacturer stating that the motor furnished with the system is compatible with the VFD and that it will meet all the requirements of this Specification.

Motors shall operate without exceeding the vibration allowances specified in NEMA MG-1-12.05.

Motors shall be equipped with a non-reverse ratchet to prevent reverse rotation of the rotating elements. Motor manufacturer shall place rotation arrows on the motors.

All motor nominal efficiency shall be determined in accordance with the latest version of IEEE Standard 112, Test Method B. Motors shall have a guaranteed minimum efficiency at full load, greater than or equal to 94%. Motors shall have a full load, minimum power factor of 85 percent.

Motors shall have an insulation system for application with variable frequency drives. Insulation shall meet the requirements of NEMA MG-1, 1993 Part 31.

VFD's shall be solid state, with a Pulse Width Modulated (PWM) output. The drive efficiency shall be 97% or better at full load and shall be 95% or better at worst case conditions. The VFD shall operate from 480 VAC±10%, three phase, 60±2 Hz power. The VFD enclosure shall be NEMA 4X.

The VFD shall be self protecting from electrical damage due to normal transients and surges in the incoming power line, grounding or disconnection of its output power, and any interruption in the incoming speed reference signal. The VFD shall be provided with automatic restart capability after an overcurrent, undervoltage, overvoltage or loss of input signal. The VFD shall start motors at the speed set by the minimum speed adjustment and ramp to set speed at the rate set by acceleration adjustment.

The motor control center (MCC) shall be 480 volt, three phase, three wire, 60 Hz and sized per the NEC to accommodate the SSS electrical equipment loads. The MCC shall be housed in a NEMA 12 enclosure. Bracing shall be 65 kAIC minimum.

The metal enclosed MCC shall be completely factory assembled and bear a UL label. All breakers shall be the product of a single manufacturer. All equipment shall be certified new and unused. All live components shall be contained in a grounded metal enclosure sized per manufacturer's requirements. Each breaker compartment shall be isolated completely from other breaker compartments by grounded metal barriers. Each breaker shall be mounted in an individual grounded compartment. Each compartment shall be fully equipped with breaker and starter as required to accommodate the SSS electrical equipment. Padlocking provisions shall be provided to lock each breaker/main disconnect in the open position.

5.7 Human Factors

The design shall use human factor engineering principles and criteria such that all equipment is easily maintainable. The control panel's controls and displays shall promote rapid operator location of any given component and maximum operator awareness of the SSS condition. Component arrangement shall promote association of related controls and displays.

The design shall provide access to each system component for operation, cleaning, and maintenance.

The design shall provide for equipment that is capable of being locked and tagged out during cleaning, maintenance, and repair.

The design shall provide engineering controls for the mitigation of noise in excess of 85 decibals, time weighted average (TWA).

5.8 Reliability/Maintainability

The system shall be designed for a 15-year life. Design life considerations extend only to components not expected to require replacement over the life of the installed system under normal operating conditions.

5.9 Design Verification

The Equipment Supplier shall hold a design review at its facility for Contractor personnel. The purpose of the review is for the Contractor to verify that the Equipment Supplier's system meets approved performance criteria. The review will also evaluate the selection of the equipment and the preshipment factory testing. Specific rationale for the selection of the equipment shall address performance and functional requirements, interface compatibility, and design life considerations at a minimum. Preshipment factory test plans shall be presented for discussion of test objectives, requirements, and configuration. The design review shall be organized such that presentations and discussion entail three days. Hard copies of presentation material shall be prepared for ten Contractor personnel attending the review. The design review shall be held thirty (30) days before the Equipment Supplier commits to fabrication or procurement of equipment.

6.0 MANUFACTURING/ASSEMBLY

6.1 General

The SSS equipment shall be constructed for the design conditions and performance requirements specified herein and in accordance with the applicable sections of the referenced codes and standards. All units of the same classification furnished with similar options shall be identical to the extent necessary to ensure interchangeability of component parts, assemblies, accessories, and spare parts.

The Equipment Supplier shall clean, furnish and completely assemble the SSS equipment at its facility. The Subcontractor shall be responsible for complete assembly and installation of the SSS in and around building CPP-1688 at the INEEL. Assembly and installation shall be performed with guidance from the Equipment Supplier's Service Engineer.

6.2 Material

Materials used shall be free from defects that would adversely affect the performance or maintainability of individual components or the overall assembly. Materials not specified herein shall be of the same quality used for the intended purpose in the Equipment Manufacturer's standard commercial practice.

6.3 Cleaning, Painting, and Coating

6.3.1 All SSS equipment shall be thoroughly cleaned. All scale, oxides, lubricants, chips, and other foreign matter shall be removed. All burrs, casting scars, and sharp edges shall be ground smooth. The Subcontractor shall submit a cleaning procedure.

6.3.2 Any painting shall be in accordance with the Equipment Manufacturer's standard practices and procedures. The ambient and material temperature shall be at least 50° F for any surfaces to be painted. Any paint or primer used shall not contain lead or chromium. MSDS's shall be supplied for the paint and primer.

6.3.3 Electrical wiring, instrumentation devices, and all manufacturer's nametags shall not be painted.

6.3.4 Stainless steel and nonmetallic surfaces shall not be painted.

6.3.5 The Subcontractor shall perform any on-site painting.

7.0 QUALITY ASSURANCE

7.1 List of Equipment Supplier's Quality Assurance Requirements

The Equipment Supplier is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Documentation of inspections shall be made available to the Contractor.

The Equipment Supplier shall submit a detailed written manufacturing/inspection/test plan. This plan shall enable the Contractor to provide a schedule for inspection hold points.

The Equipment Supplier must document, implement, and maintain a Quality Assurance Program consistent with the requirements of ASME NQA-1-1997, ISO 9001, or Contractor approved equivalent.

7.2 Performance Tests (Factory Preshipment)

The Equipment Supplier shall submit to the Contractor an "in-shop" testing plan and procedure prior to demonstration of the Soil Stabilization System capabilities at the Equipment Supplier's facility. The plan and procedure shall include the date, test conditions, duration of testing, testing sequence, materials used, and methods of performing the tests.

Other than SSS equipment defined in this Specification, the Equipment Supplier shall provide everything needed to perform the "in-shop" tests including:

- One 2' x 4' x 8' wooden box similar to those containing the waste at the INEEL.
- Soil that weighs approximately 8,000 pounds that simulates the soil gradations listed in Section 5.1.2.
- Portland Cement with a die additive. The die additive is used to determine how well the soil/cement combination is mixed.
- A forklift capable of loading the 2' x 4' x 8' wooden box onto the Box Unloader as well as removing the 2' x 4' x 8' box from under the Mixer.

Factory testing shall demonstrate that all equipment operates and interfaces together into a functional Soil Stabilization System as defined within this Specification.

Testing acceptance criteria:

- Box Unloader: Must be capable of unloading 8,000 pounds of soil from a 2' x 4' x 8' box into the Mixer.
- Mixer: Provides a homogeneous blend of soil and Portland Cement. Mixer is capable of accepting liquid (water) with no leakage. Mixer is capable of delivering soil back into the 2' x 4' x 8' boxes as well as a 20 cubic yard roll-on/roll-off container.

Successful demonstration of Mixer washdown system. Successful VFD functionality test per requirements listed in Section 5.6.

- Air Scavenger System: Provides total elimination of fugitive dust emissions. Dust levels must be maintained below 40 $\mu g/m^3$ during all soil transfer operations. Air introduced into HEPA filters is below 90% relative humidity.
- Remote Station Process Control: Shall demonstrate the monitoring, communication, and process control features of the Mixer as listed in Section 5.5.

Subsequent to "in shop" testing, the Equipment Supplier shall submit to the Contractor a written test report documenting the results of "in-shop" testing. The test reports shall be submitted to and approved by the Contractor prior to shipment to the INEEL.

7.3 Performance Tests (On-Site, INEEL)

The Equipment Supplier shall submit to the Contractor a systems operability (SO) testing plan and procedure prior to SO testing the SSS at the INEEL. The (SO) plan and procedure shall include the date, test conditions, duration of testing, testing sequence, materials used, and methods of performing the tests. The Equipment Supplier shall also submit, subsequent to SO testing, a signed SO testing report warranting that all SSS components have been commissioned, adjusted, and are performing to design Specifications.

The Subcontractor is responsible for assembly and installation of the Soil Stabilization System at the INEEL under the guidance of a Service Engineer from the Equipment Supplier.

The Contractor is responsible for providing the 2' x 4' x 8' boxed waste soils, aqueous liquid/sludge wastes, and reagents for the SO testing activities. The Contractor is also responsible for conducting the TCLP.

On-Site testing shall demonstrate that all equipment operates and interfaces together into a functional Soil Stabilization System as defined within this Specification.

Testing acceptance criteria:

- Box Unloader: Must be capable of unloading 8,000 pounds of waste soil from a 2' x 4' x 8' box into the Mixer.
- Mixer: Provides a homogeneous blend of waste soil and reagents. Mixer is capable of delivering soil back into the 2' x 4' x 8' boxes as well as a 20 cubic yard roll-on/roll-off container. Successful VFD functionality test per requirements listed in Section 5.6.
- Air Scavenger System: Provides total elimination of fugitive dust emissions. Dust levels must be maintained below 40 $\mu g/m^3$ during all soil transfer operations. Air introduced into HEPA filters is below 90% relative humidity.
- Remote Station Process Control: Shall demonstrate the monitoring, communication, and process control features of the Mixer as listed in Section 5.5.

Subsequent to "On-Site, INEEL" testing, the Equipment Supplier shall submit to the Contractor a written test report documenting the results of testing activities. The test reports shall be submitted to and approved by the Contractor after testing activities are completed at the INEEL.

7.4 Welding

This specific design does not allow for welding or welding repairs at the INEEL. However, if the Subcontractor determines that welding is required, the Contractor's approval must be obtained prior to performance of any welding. Such approval may be granted only upon the establishment of Contractual Specifications, procedures and qualification requirements to be applied to the welding. Any welding performed at the Equipment Supplier's site shall comply with American Welding Society (AWS) requirements.

7.5 Certificates of Conformance

Equipment Supplier's Certificates of Conformance shall be furnished for all major components. Each Certificate of Conformance shall:

A. Identify the equipment purchased.
B. Identify specific procurement requirements that have met the following:

   1. Referenced codes and standards.
   2. This Specification.
   3. Approved changes, waivers, or deviations.

C. Certify that the items furnished are of the proper design and are mechanically and electrically suited to meet the operating conditions as stated in this Specification.

8.0 EXECUTION

8.1 Installation

8.1.1 The Subcontractor shall furnish an Equipment Supplier's Service Engineer to provide technical direction for the Subcontractor's installation, field testing and initial operation of the equipment. The Service Engineer shall also provide training on the equipment. The extent of services and responsibilities of the Service Engineer shall include testing, training, and start-up of all electrical and mechanical components. The Service Engineer shall be an expert in all fields required to allow him to troubleshoot and repair any portion of the system. The Service Engineer shall report directly to the Contractor.

8.1.2 The Subcontractor shall notify the Contractor as far in advance as practical, but not less than ten (10) working days before, the date for initiation of the services of the Service Engineer.

8.1.3 The Equipment Supplier's Service Engineer shall instruct the Subcontractor on the interface between the SSS and plant tie-ins. The Service Engineer shall verify proper installation of the SSS. The Equipment Supplier shall allow twelve (12) working days and three (3) trips to the installation site (INEEL) for technical support activities. A working week is four (4) 10-hour days. Time allotted for technical support is 120 hours.

8.1.4 The Service Engineer shall submit daily reports to the Contractor covering field activities of the installation and testing.

8.1.5 Installation drawings will be prepared by the Contractor to incorporate the equipment into the facility and show location of interfaces. The Subcontractor shall submit all information required for the Contractor to prepare the installation drawings, such as pad requirements and connection locations.

8.1.6 The Subcontractor will be responsible for supplying construction material for connection of the SSS to the plant tie-ins.

8.2 Startup and Calibration

All start-up and testing shall be performed by the Equipment Supplier's Service Engineer in accordance with technical guidance of this Specification.

The SSS shall be performance tested on site (INEEL) prior to turnover to Contractor and the test data shall be incorporated by the Subcontractor into the Operations and Maintenance Manual.

Instrumentation for controlling the process and taking data must be calibrated by the INEEL Calibration Laboratory.

8.3 Training

The Equipment Supplier's Service Engineer shall provide technical training at the INEEL for Operations and Maintenance personnel. The training, as a minimum, shall include four (4) days of course and field instruction, for six (6) people, and shall include all training materials. The training may coincide with the start-up and commissioning of the system. Time allotted for technical training is 40 hours.

8.4 Maintenance

The Subcontractor shall submit evidence that a permanent service organization is available to render necessary services for the equipment on a regular basis, including the name and telephone number of the person to contact for services. The Subcontractor shall identify if the services will be rendered by the specific Equipment Manufacturer or if the Equipment Supplier is trained and authorized by the Equipment Manufacturer(s) to service the SSS equipment.

9.0 PACKAGING AND SHIPPING

9.1 Packing and Packaging

The SSS equipment shall be inspected for packaging, preservation, and marking for shipment to verify conformance with the terms of this Contract. All openings shall be covered to prevent entry of foreign material. The SSS equipment shall be preserved to prevent damage from moisture during shipment and storage. Partial assemblies, structures, and components shall be adequately supported, cushioned, and restrained for shipment without damage.

Instrumentation devices shall be protected from damage and contamination during shipment.

Packing and packaging will be subject to inspection and approval by the Contractor. Materials used in packaging including, but not limited to, resins used in plywood, shipping gaskets, plastic sheeting, and tarps shall be chloride free. Packaging and shipping procedures shall include the make, model, trade name, and material of all items used for packaging. As a minimum, preparation for shipment of the SSS shall include the following:

Internal and external parts shall be suitably supported and braced to prevent damage during handling and transporting.

A waterproof tarp shall be provided to completely cover each piece of equipment if storage at the construction site is necessary.

Preparation for shipment shall be in accordance with the Equipment Supplier's approved packaging and shipping procedure and shall provide protection from damage and contamination during shipment, handling and six months outdoor storage at INTEC.

9.2 Marking and Handling

An identification tag of corrosion-resistant metal shall be permanently affixed to each piece of equipment. Each tag shall include the Equipment Manufacturer's name, model and serial number. Similar identification tags shall be affixed to the drivers, to include horsepower and other salient features of the motor.

Shipping containers shall be identified by the purchase order number, equipment item number, total shipping weight, and description of contents (using 2-inch high lettering minimum) with ink, paint, or other indelible material markings on two adjacent sides of the container.

All motors shall have a stainless steel nameplate that states the service factor minimum and nominal full load efficiencies and the full load power factor in accordance with NEMA MO-1. In accordance with NEMA MO-1, the nameplate shall designate the maximum number of starts and the required cooling period when a motor is started under conditions of (a) cold rotor and, (b) warm rotor (after running continuously at full load for a period of one (1) hour).

ATTACHMENT A

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VENDOR DATA REQUIREMENTS

The Supplier shall furnish to the Contractor the specified number of copies of required vendor data for disposition, sufficiently in advance of the date that the material/equipment/service is required to be delivered and/or completed as defined by the Purchase Order. The Vendor Data Requirements form summarizes the submittal requirements of the Purchase Order and generally specifies the timing for each required submittal. Vendor data for all material and equipment requiring a disposition shall be submitted, reviewed, assigned a disposition code by the Contractor and returned to the Supplier. Unless designated as With Shipment, Vendor data shall be submitted under cover of Contractor form 540.03, Vendor Data Transmittal and Disposition, to:

Bechtel B&W Idaho (BBWI), LLC.
Procurement Document Control
P. O. Box 1625
Idaho Falls, ID 83415-3521

Vendor Data shall be legible, reproducible, and comply with all applicable Purchase Order requirements. Vendor data submittals shall not be utilized to request deviations from, or changes to, the Purchase Order. Vendor data shall be submitted on a stand-alone basis. Reference to, or review of, previous submittals is prohibited. Vendor data shall clearly identify the submittal item and the submittal number to which it applies.

The Supplier and all lower-tier suppliers shall perform no work for which the vendor data has not been reviewed and dispositioned by the Contractor in accordance with the Vendor Data Requirements.

Vendor data causing any change to design details, layouts, calculations, analysis, test methods, procedures, or any other Purchase Order requirements shall be identified to the Contractor utilizing form 540.16, Interface Document.

Vendor Data disposition codes are:

'A' - (APPROVED), Related work may proceed.
'B' - (APPROVED W/COMMENTS), Related work may proceed ONLY after comments have been incorporated or otherwise reconciled.
'C' - (DISAPPROVED), Related work shall NOT proceed. Resubmit.
'D' - (INFORMATION ONLY SUBMITTAL - RECEIPT ACKNOWLEDGED), No further action is required.

ATTACHMENT A

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VENDOR DATA REQUIREMENTS

Requisition No.: ____________________

Item Number	Item Description	Clause/Article Reference	Specification Reference	Quantity/Schedule				Contractor Reviews										Contractor Approval Required/ Info Only
				BFR	BU	PS	WS	Requestor	Procurement QA	Operations	Engineering	Program QA	Procurement Agent					
1	Design Verification	341	4.6/5.9	8				X	X	X	X		X					A
	Specification																	
2	Design Calculations	321	4.9	8				X	X	X	X		X					A
	Characteristic Calculations																	
	Performance Calculations																	
3	Test Reports	723	4.1/7.2			8		X	X	X	X		X					A
	Correction Calculations																	
	Characteristic/Performance Curves - ☒ Actual ☐ Typical																	
	Characteristic Curves																	
	Performance Curves																	
	Test Result Curves																	
	Calibration Curves																	
	Operating Curves																	
	Correction Curves																	
	Design/Qualification Testing																	
4	Catalog Data	333	4.11			8		X	X	X	X		X					I
	Engineering Drawings/Reproductions																	
5	Schematics	332	4.8	8				X	X	X	X		X					I
	Block Diagrams																	
	Piping Plan																	
	Piping Elevation																	
	Foundation Plan																	

BFR – Before Fabrication Release   BU – Before Use By Supplier   PS – Prior To Shipment   WS – With Shipment   A – Approval Required   I – Information Only

ATTACHMENT A

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VENDOR DATA REQUIREMENTS

Requisition No.: ____________________

Item Number	Item Description	Clause/Article Reference	Specification Reference	Quantity/Schedule: BFR	BU	PS	WS	Contractor Reviews: Requestor	Procurement QA	Operations	Engineering	Program QA	Procurement Agent					Contractor Approval Required/ Info Only
6	Electrical Wiring Diagrams	332	5.5/5.6			8		X	X	X	X		X					I
7	General Arrangement Drawings	332	4.8	8				X	X	X	X		X					I
8	Structural Detail Drawings	332	4.8	8				X	X	X	X		X					I
9	Assembly Drawing	332	4.8	8				X	X	X	X		X					I
	Interface Drawing																	
	Flow Diagrams (P. & I.D.)																	
	Panel Cutout Drawings																	
	Original As Built Tracings (Sepia)																	
10	Weight of Unit	332	4.8	8				X	X	X	X		X					I
	Descriptive Data																	
	Connection Drawing																	
	Weld Map and History																	
11	Manufacturing/Inspection/Test Plan	721	4.1/7.2/7.3	8				X	X	X	X		X					A
12	Traceability Procedure	442	-		8			X	X	X	X		X					I
	Bill of materials																	
13	Cleaning Procedure	-	4.5/6.3	8				X	X	X	X		X					A
	Heat Test Procedure																	
	Sensitive leak Test Procedure																	
	Hydrostatic Test Procedure																	
	Pneumatic Test Procedure																	
	Liquid Penetrate Test procedure																	
	Magnetic Particle Test Procedure																	

BFR – Before Fabrication Release   BU – Before Use By Supplier   PS – Prior To Shipment   WS – With Shipment   A – Approval Required   I – Information Only

Specification	SSSTF SOIL STABILIZATION SYSTEM (SSS) PROCUREMENT SPECIFICATION	Identifier:	SPC-1481
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VENDOR DATA REQUIREMENTS

Requisition No.: ______________________

Item Number	Item Description	Clause/Article Reference	Specification Reference	Quantity/Schedule				Contractor Reviews										Contractor Approval Required/ Info Only
				BFR	BU	PS	WS	Requestor	Procurement QA	Operations	Engineering	Program QA	Procurement Agent					
	Radiographic Procedure																	
	Ultrasonic Test Procedure																	
	Visual Examination Procedure																	
	Weld Procedure/Qualification																	
	Welder Performance Personnel Certification																	
14	Electrical Continuity Test	723	5.5/5.6		8			X	X	X	X		X					I
	Continuity/Resistance Test Procedure																	
	Free Iron Test Procedure																	
	Calibration Procedure																	
15	Inspection/Test Procedures and Reports (On site, INEEL)	721	4.1/7.3		8			X	X	X	X		X					A
	Weld Joint Test Specimens																	
	Non Destructive Examination Personnel Certifications																	
	Inspector Certifications																	
	Test Certifications																	
	Serialization Procedure																	
16	Inspection Test Data	723	4.1			8		X	X	X	X		X					I
	Limited Shelf Life/Operational Life Data																	
17	Recommended Spares	822	4.2			8		X	X	X	X		X					I
18	Manufacturer's Manuals	821	4.7			8		X	X	X	X		X					I
19	Special Tools List	-	4.2			8		X	X	X	X		X					I
20	Installation Manual (including drawings)	821	4.7			8		X	X	X	X		X					I
21	Maintenance Manual	821	4.7			8		X	X	X	X		X					I

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Specification	SSSTF SOIL STABILIZATION SYSTEM (SSS) PROCUREMENT SPECIFICATION	Identifier: SPC-1481
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Rev. 05

VENDOR DATA REQUIREMENTS

Requisition No.: ____________________

Item Number	Item Description	Clause/Article Reference	Specification Reference	Quantity/Schedule BFR	BU	PS	WS	Contractor Reviews Requestor	Procurement QA	Operations	Engineering	Program QA	Procurement Agent	Contractor Approval Required/ Info Only
22	Operating Manual	821	4.7			8		X	X	X	X		X	I
	Chemical/Physical Test Reports – ☒ Actual ☐ Typical													
23	Certificate of Conformance	432	7.5				8	X	X	X	X		X	I
24	Special Packaging, Shipping, and Rigging Procedures	832	4.3/5.1.9/9.1			8		X	X	X	X		X	A
	Certification of Materials to ASME Code													
	Certificate of Disposal or Destruction													
	Additional Submittal Requirements													
25	Daily Reports (On-Site, INEEL)	-	8.1.4		8			X	X	X	X		X	I
26	Inspection Test Procedures and Reports (Factory Preshipment)	721	4.1/7.2			8		X	X	X	X		X	A
27	Material Safety Data Sheets (MSDS)	-	4.4/6.3.2	8				X	X	X	X		X	A
28	Point-By-Point Response	-	1.2	8				X	X	X	X		X	A
29	Minimum Qualifications of Equipment Supplier	-	2.1	8				X	X	X	X		X	I
30	Service Requirements	-	4.10	8				X	X	X	X		X	I
31	Quality Assurance Program Requirements	-	4.13/7.1	8				X	X	X	X		X	A
32	Software/Hardware/PLC	-	5.5			8		X	X	X	X		X	A
33	Equipment Service Organization	-	8.4		8			X	X	X	X		X	I
34	Electrical Requirements	-	5.1.5			8		X	X	X	X		X	I
35	Warranty	-	4.12				8	X	X	X	X		X	I
36	Lifting and Tie Down	-	5.1.9				8	X	X	X	X		X	I
37	Training Outline	-	1.2/8.3			8		X	X	X	X		X	A
38	Maintenance Platform Design/Drawings	-	5.2				8	X	X	X	X		X	A
39	VFD Functionality Test Procedure/Report	-	5.6/7.2		8			X	X	X	X		X	A

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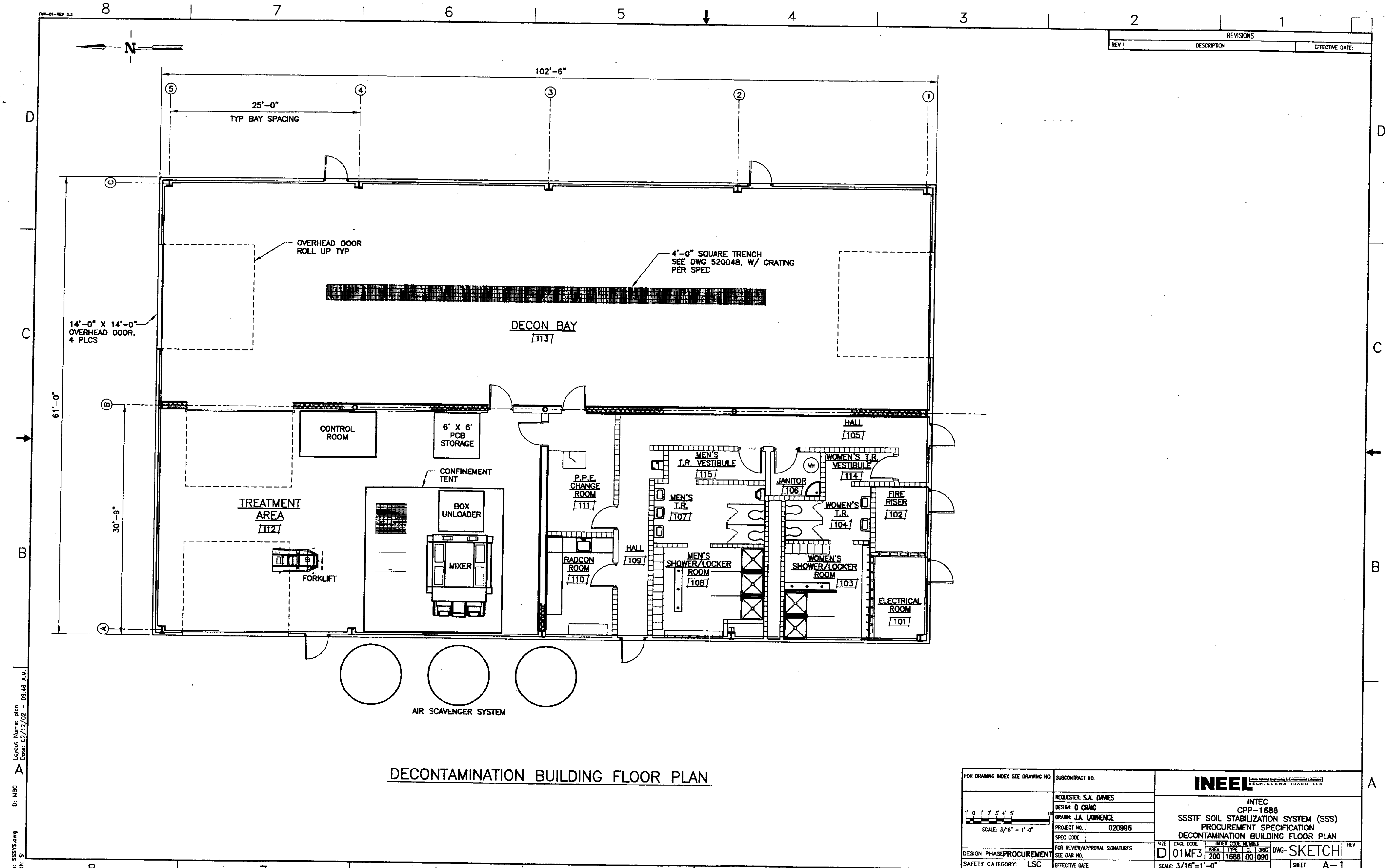

Attachment A-1. Floor plan of Decon Building (CPP-1688, Drawing A-1).